2018-06-01

# Ice and Fire: An Analysis of Glacier-Volcano Interactions

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# ICE AND FIRE: AN ANALYSIS OF GLACIER-VOLCANO INTERACTIONS

Aaron Orr

Academic Excellence Showcase

5/31/2018

# OVERVIEW

- Geospatial Occurrence of Glaciers and Volcanoes
  - Where and Why
- Iceland: Ice Sheets and Hot Spots
  - Interactions and Impacts
  - Eyjafjallajökull
- Pacific Northwest: Different Conditions, Similar Hazards
  - Alpine Glaciers and Stratovolcanoes
  - Mt. Rainier
- Discussion of both locations and overall hazards


Sweden
Norway
Poland
Denmark
Czechia
Netherlands
Belgium
Italy
Ireland
France
Iceland
Greenland
Tunisia
Spain
Portugal
Algeria
Morocco
Western Sahara
Senegal
The Gambia
Canada
United States
Mexico
Cuba
Dominican Republic
Puerto Rico
French Guiana
Guatemala
Honduras
Nicaragua
Costa Rica
Panama
Venezuela
Guyana
Colombia
Google
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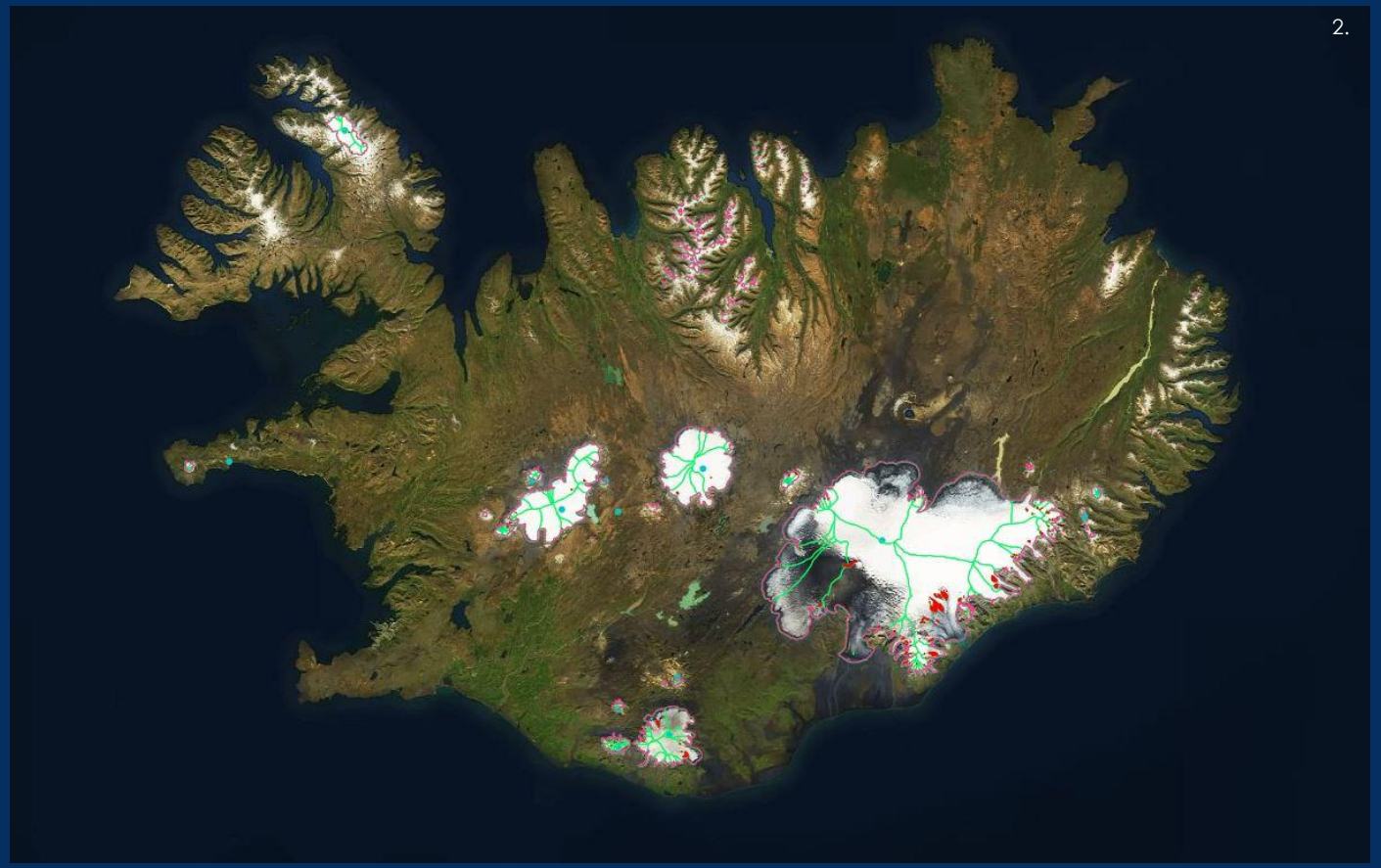
# ICELAND AND CONTINENTAL GLACIER-VOLCANO INTERACTIONS

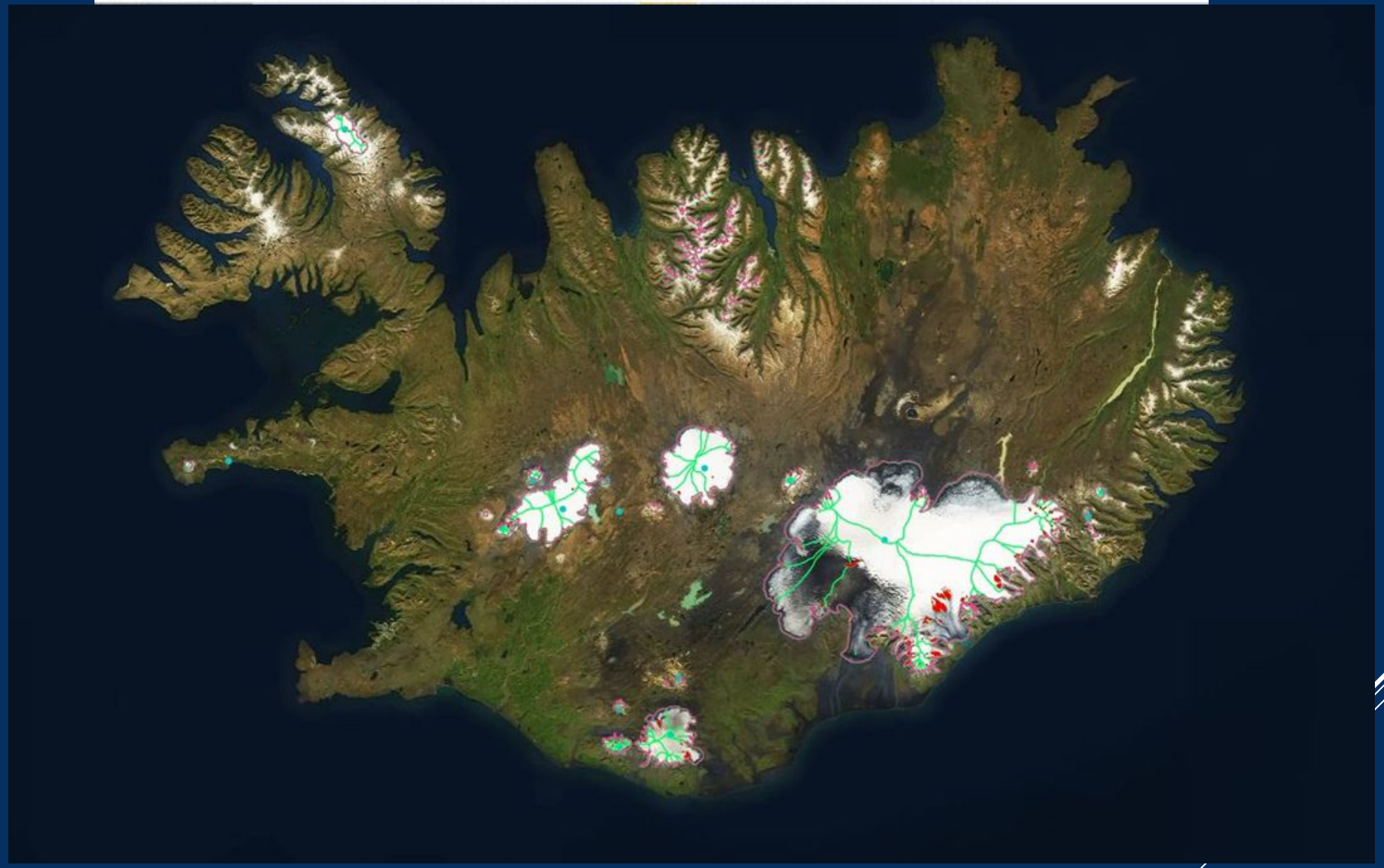



# ICELAND

- Polar Region, continental ice sheets
- 10% Covered in Ice
  - 60% of that overlies volcanoes
- Common co-occurrence of glaciers and volcanoes
- Glaciovolcanism hazards are common

# Iceland's major volcanoes and tectonic plate boundaries





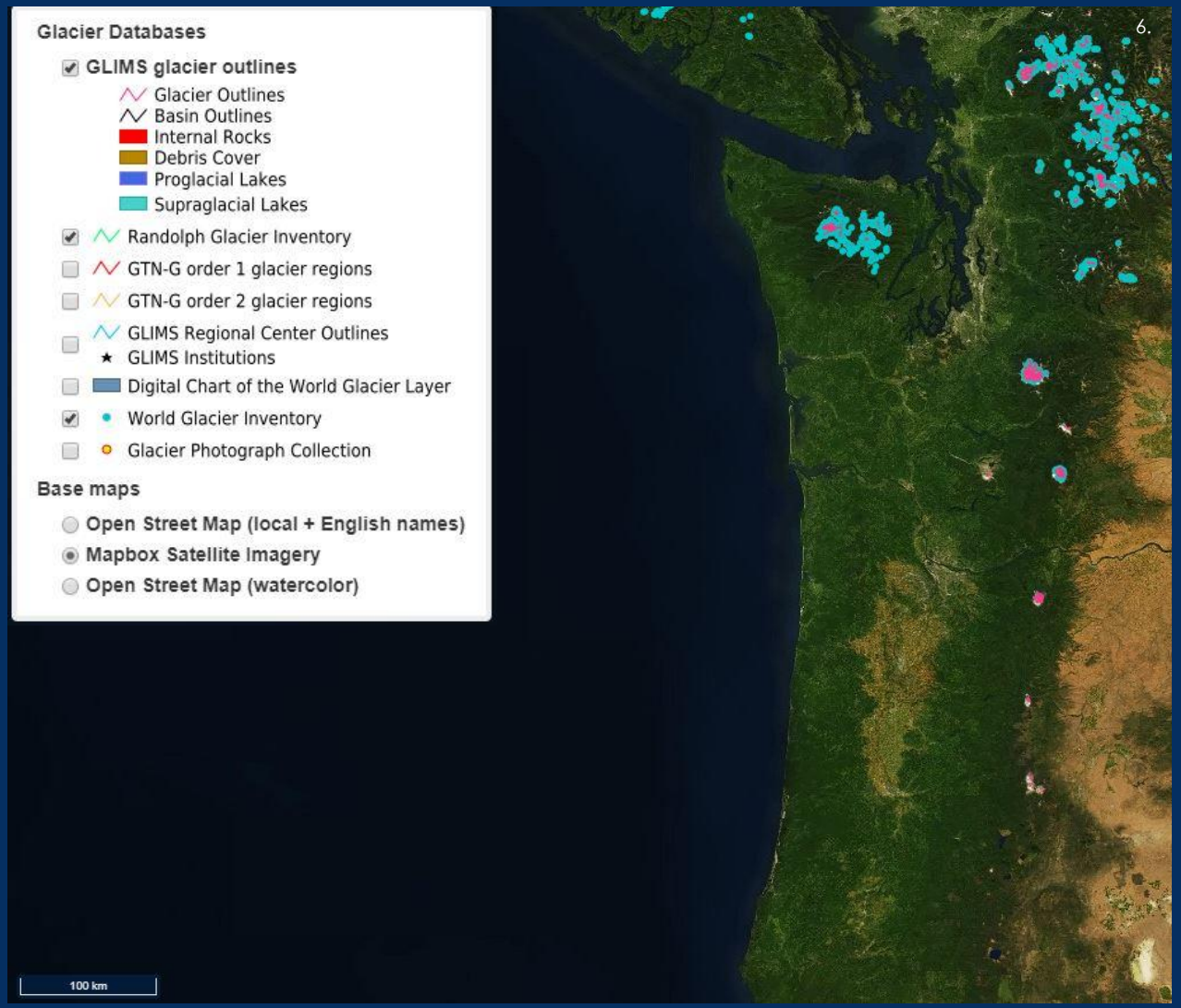

# GLACIOVOLCANIC HAZARDS IN ICELAND

- Jökulhlaups
  - Outburst Floods from geothermal heating
  - Can be triggered by volcanic eruptions
  - Volcanism not Required
- Common in Iceland
  - Eyjafjallajökull
  - Kverkfjoll
- Lahars and Debris Flows
  - Helgi Bjornnson (2002) and Gudmundsson (2010)


# EYJAFJALLAJÖKULL

- Not just conjecture
- April 13, 2010 eruption
- 1:15 AM eruption, 6:50 AM flood
  - Gaging station

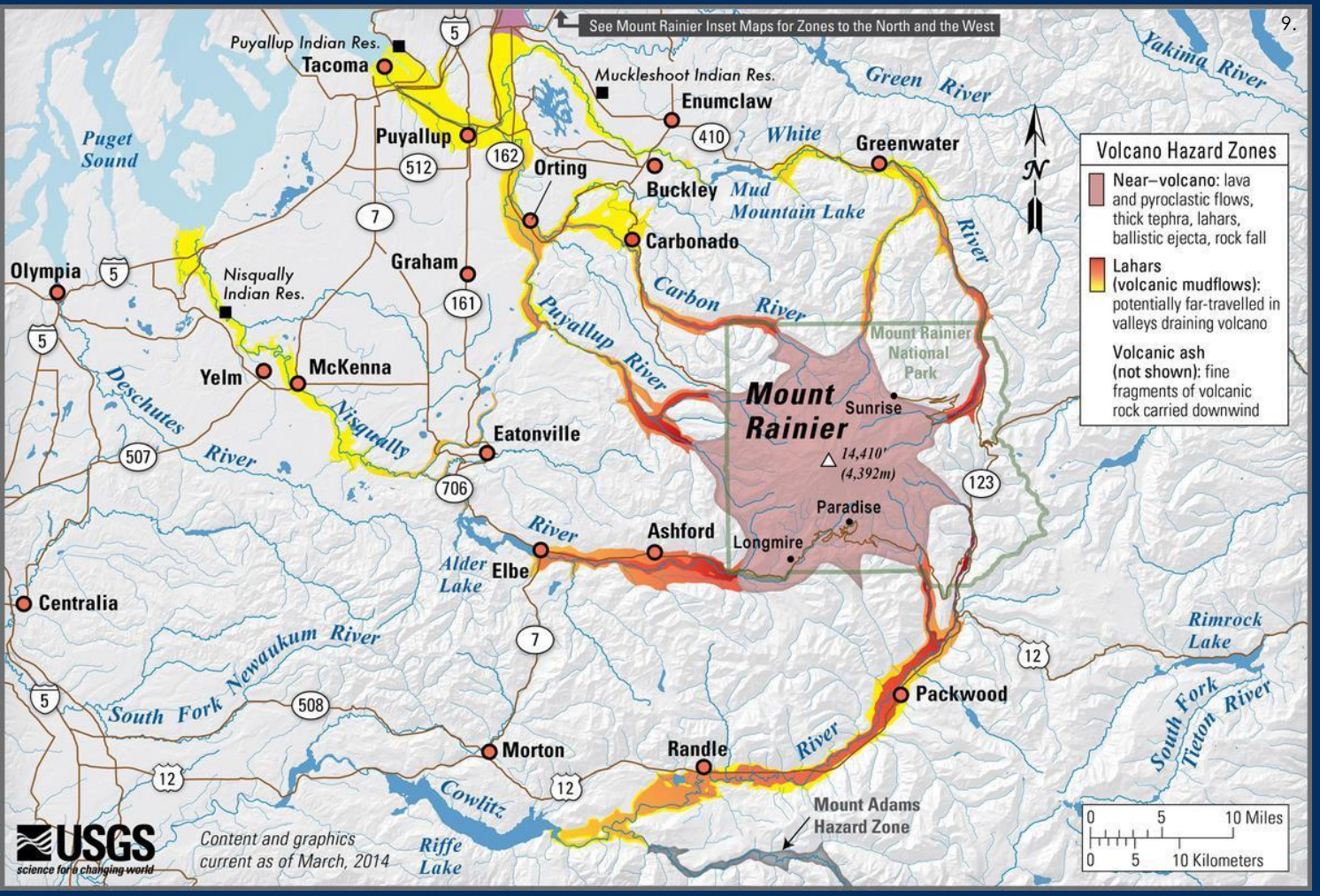
# PACIFIC NORTHWEST GLACIER-VOLCANO INTERACTIONS


Glacier Databases
GLIMS glacier outlines
Glacier Outlines
Basin Outlines
Internal Rocks
Debris Cover
Proglacial Lakes
Supraglacial Lakes
Randolph Glacier Inventory
GTN-G order 1 glacier regions
GTN-G order 2 glacier regions
GLIMS Regional Center Outlines
GLIMS Institutions
Digital Chart of the World Glacier Layer
World Glacier Inventory
Glacier Photograph Collection
Base maps
Open Street Map (local + English names)
Mapbox Satellite Imagery
Open Street Map (watercolor)
100 km
6.


Mount Baker
Glacier Peak
WASHINGTON
Mount Rainier
Mount Adams
Mount St.Helens
Mount Hood
Mount Jefferson
Three Sisters
Newberry
OREGON
Crater Lake
Medicine Lake
Mount Shasta
Lassen Peak
CALIFORNIA
100 km
7.

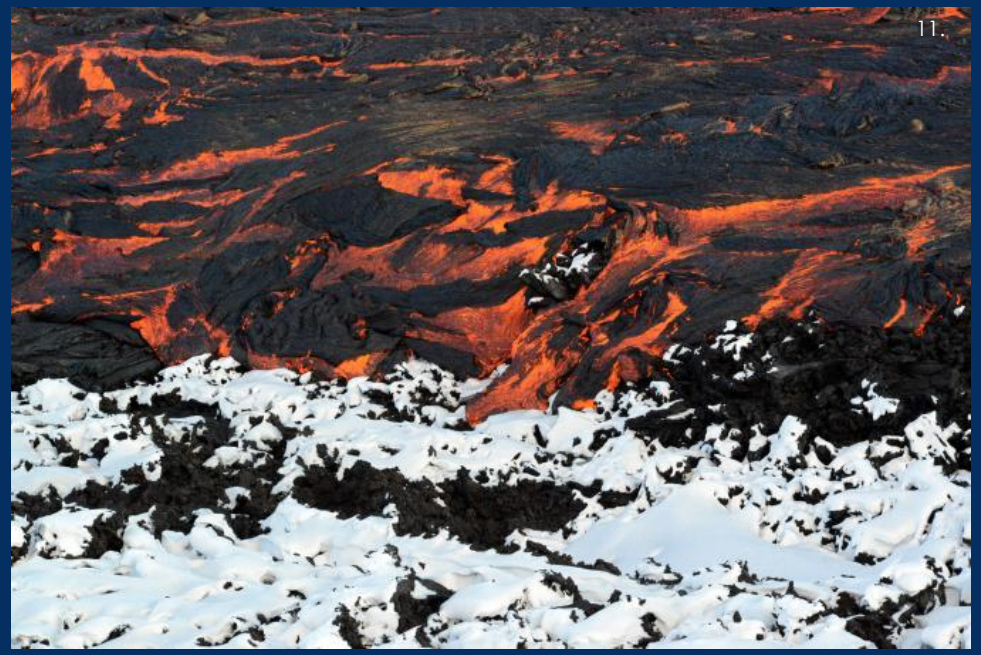
# PACIFIC NORTHWEST GLACIERS

- Alpine glaciers
- Less area, based on elevation
- Affect volcanoes geomorphologically and petrologically
- Mt. Rainier




# POTENTIAL HAZARDS IN THE PNW: WHY THEY ARE SIGNIFICANT

- Proximity to cities i.e. Mt. Rainier
  - Seattle, surrounding suburbs
- Potential Hazards not high risk
  - Low frequency
- Many possibilities
  - Interactions
  - geomorphology


# GEOMORPHOLOGY AND GLACIATION

- Facilitators of lava flow
  - Subglacial tunnels
  - Glaciated slopes (Glacier Peak)
  - Trenches
  - Lescinsky and Fink synthesized results from 18 glaciated volcanoes

# ICELAND AND PACIFIC NORTHWEST COMPARISON

## Iceland

- Continental Glaciers
- Jokulhlaups
  - Shield volcanoes
- Ice and volcanoes are predominant
- Risk is high and citizens are prepared
- Cool sounding volcanoes
- Pose a threat to surrounding cities

## Pacific Northwest

- Alpine Glaciers
- Geomorphologically Significant
- Lahars and Debris flows
  - Stratovolcanoes
- Ice and volcanoes are rare
- Risk is low and citizens are not as prepared
- Okay-sounding volcanoes
- Pose a threat to surrounding cities

# CONCLUSION

- Occurrences are more common in areas with continental ice sheets
- Recent activity of Eyjafjallajökull
- Risks is lower but less prepared for in Pacific Northwest
- Stratovolcanoes are steeper and may increase severity of lahars and debris flows instead of jokulhlaups
- With glacier inventory decreasing, risk decreases but geomorphology of glaciated regions remain

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